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5.4.5 Exterior Lighting

Exterior lighting improves security, enhances safety, and directs pedestrians and vehicles. It is also used in nighttime work areas, sports facilities, landscapes, and cityscapes. A wide selection of new lamps, ballasts, fixtures, and controls are available to lighting designers to replace inefficient exterior lighting systems. The use of white light sources increases nighttime visibility and maximizes peripheral vision. With any exterior lighting design it should be a high priority to avoid light pollution (the upward transmission of light) and light trespass (glare obnoxious to neighbors)—careful luminaire and lamp selection can minimize these problems.

Opportunities

Most exterior lighting systems using incandescent, mercury vapor, or sodium lamps should be evaluated, redesigned, and replaced with new hardware using compact fluorescent or metal halide lamps. In locations with nearby astronomical observatories, low-pressure sodium lighting may be appropriate, but otherwise both low-pressure and high-pressure sodium lighting should be avoided because the poor color rendering makes night vision very inefficient. Incandescent (halogen) exterior lighting may be appropriate when used with motion sensors where instant illumination is required and the total "on" time is low.

Exterior lighting systems that currently result in inappropriate glare, light trespass, and light pollution should be replaced. A parking lot that is lighted with floodlights, for example, can be relighted with IESNA full-cutoff luminaires and appropriate low-wattage lamps.

Technical Information

Exterior lighting principles should be considered when implementing any exterior lighting retrofit or new design. These principles assist in achieving energy conservation, provide superior lighting quality to users, and help preserve the night sky.

Minimize glare. Glare greatly detracts from nighttime visibility. If two parking lots are equally illuminated to 5 footcandles, the installation with the least glare from the fixtures will provide the greatest visibility, safety, and visual comfort. *Veiling luminance* is a numerical measure of glare and needs to be considered in roadway and parking area illumination calculations. *Light trespass potential* can also be evaluated.

Minimize or eliminate light directed upward. Light emitted at angles of 80° or higher (straight down is 0°) fails to produce useful illumination on horizontal surfaces in open areas such as parking lots. At these high angles light produces significant glare, light pollution, and wasted energy. Light above 90° (horizontal) is totally wasted and produces undesirable sky glow.

Direct light only where it is needed. New fixtures allow designers to control where light falls. By eliminating light spillage into surrounding areas, lower wattage lamps can be used. "Barn lights" that contain 175-watt mercury vapor lamps, wall packs, and floodlights are good examples of fixtures to avoid.

Avoid overlighting. Refer to the *IESNA Lighting Handbook – 9th Edition* (2000) for lighting quality and quantity guidelines. Minimum levels are required for different uses, with maximum to minimum uniformity requirements. Lighting quality is directly related to good uniformity, not to the number of footcandles. A good rule of thumb is that "a little light is a lot of light where there isn't any other light."

Consider human usage patterns. Where pedestrians are likely along roadways, for example, provide high-quality (white) vertical light that allows plenty of time for both pedestrians and motorists to be seen.

LAMP AND BALLAST SELECTION

Mercury vapor lights should be avoided. Replace mercury vapor lights with metal halide lights whenever possible.

Low-pressure sodium lamps provide the highest efficacy (lumens per watt) of any light source, but this light source is appropriate only in rare situations. The monochromatic yellow light they produce has absolutely no color rendering capability. Three cars—red, blue, and black—may all appear identical under these lights. In fact, despite the high efficacy, low-pressure sodium is actually among the least efficient nighttime light sources in terms of providing visibility. However, if astronomical observatories are nearby, low-pressure sodium may be a desirable exterior lighting option because filters for specific wavelengths can be installed on telescopes.

High-pressure sodium lights, though they provide significantly better light quality than low-pressure sodium, do not provide nearly as good nighttime illumination as metal halide (a much whiter light). They do offer long life, however. Many high-pressure sodium ballasts with igniters can accept metal halide lamp retrofits.

Source: Kim Lighting

Full-cutoff luminaires direct nearly all of their light downward, thus reducing light pollution.

Metal halide is generally the best option when very high levels of illumination are required. The efficacy is good and the light is very white.

Inductive lamps provide high-quality white light and are an increasingly attractive exterior lighting option.

Compact fluorescent exterior lighting is appropriate for many applications, especially along walls and in low outdoor fixtures.

Some high-intensity discharge (HID) ballasts incorporate control circuits that allow easy attachment of motion sensors or energy management system controls. To maximize lamp life, specify ballasts that provide the least amount of voltage variation to the lamps.

Use HID lamps with specific orientations rather than universal position lamps. Lamps that specify burning in the horizontal, base-up, or base-down positions can produce 10–20% more light and last up to 60% longer.

Consider photovoltaic lighting for remote sites not yet served by power lines. Locations requiring low levels of light that are further than 50 feet (15 m) from a power source can be good applications for PV lighting. Examples are signs and bus shelter lights (See *Section 5.8.5 – Photovoltaics*).

CONTROL AND MAINTENANCE

Turn off lights by 11:00 p.m. unless they are needed for security or safety. In little-used parking areas, illumination may not be needed that late. Consider motion sensors when only brief periods of illumination are needed.

Control of exterior lighting may be provided by manual switches, time clocks, photocells, motion sensors, or sophisticated energy management systems. FM-frequency and satellite controls are available for very large installations. By automating controls, users need not manually switch lights on and off each night. Where time clocks are used, however, they should be periodically checked to ensure that the time is set correctly and adjusted for changes in time of sunrise and sunset. Where photocells are used, they should be very sensitive to low light levels and placed in open areas, such as on roofs. This will help to ensure that lights do not operate unnecessarily at dusk and dawn. See *Section 5.4.4 – Lighting Controls* for more information about control systems.

Design systems to provide for cost-effective maintenance. To reduce maintenance costs, provide long ballast and lamp lives, and provide equipment that is resistant to dirt, animal droppings, birds' nests, vandalism, and water damage.

Relamp groups of fixtures at the same time to reduce maintenance costs, lamp stocking, and light depreciation toward the end of lamp life.

References

IESNA Lighting Handbook – 9th Edition, Illuminating Engineering Society of North America, New York, NY, 2000; (212) 248-5000; www.iesna.org.

Leslie, Russell, and Paula Rodgers, *The Outdoor Lighting Pattern Book*, McGraw-Hill, New York, NY, 1996.

Lighting for Exterior Environments (RP-33-99), Recommended Practice Series, Illuminating Engineering Society of North America, New York, NY, 1999.

Contacts

International Dark-Sky Association, 3545 N. Stewart Avenue, Tucson, AZ 85716; www.darksky.org/; offers information on techniques for providing good outdoor lighting without contributing unnecessarily to light pollution.